CLAIMS

What is claimed is:

1. A magnetically detectable particle for generating a temperature measurement for a batch or a continuous stream of material, the particle comprising:

(a) a first and second magnet each comprising a positive and negative pole; and

(b) an adhesive having a release temperature and operable to attach one or both of the positive and negative poles of the first magnet proximate to the same polarity pole of the second magnet or to attach one of the positive and negative poles of the first magnet between the poles of the second magnet below the release temperature such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another above the release temperature,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream.

2. The magnetically detectable particle of claim 1, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets have a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of

the positive and negative poles of the first magnet is attached to the same polarity pole of the second magnet.

3. The magnetically detectable particle of claim 1, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the same polarity pole of the second magnet.

4. The magnetically detectable particle of claim 1, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

5. The magnetically detectable particle of claim 1, wherein the adhesive comprises a material selected from the group consisting of glue materials, metallic alloys, single or multi-component epoxies, epoxy films, thermo-resistant cyanoacrylate adhesives, and combinations thereof.

6. The magnetically detectable particle of claim 1, wherein the adhesive comprises a material selected from the group consisting of indium, bismuth, tin, lead, cadmium, silver, and combinations thereof.

7. The magnetically detectable particle of claim 1, wherein the adhesive comprises a metal alloy and a first and second thermo-resistant adhesive, wherein the metal alloy is attached to the first and second magnets via the first and second thermo-resistant adhesive, respectively.

8. The magnetically detectable particle of claim 1, wherein the release temperature is a conservative temperature.

9. The magnetically detectable particle of claim 1, wherein the adhesive comprises a release temperature of about between -40°C and 1000°C.

10. The magnetically detectable particle of claim 1, comprising a carrier particle.

11. The magnetically detectable particle of claim 9, wherein the carrier particle defines an interior cavity for holding the adhesive and the first and second magnets.

12. The magnetically detectable particle of claim 10, wherein the carrier particle comprises conservative behavior characteristics in a batch or continuous stream of material.

13. The magnetically detectable particle of claim 1, wherein the first and second magnets comprise a series of magnets each comprising a positive and negative pole, wherein opposing polarity poles of the magnets in series are attached.

14. A method of generating a temperature measurement for a batch or a continuous stream of material, the method comprising:

(a) providing a magnetically detectable particle comprising:

(i) a first and second magnet each comprising a positive and negative pole; and

(ii) an adhesive having a release temperature and operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet or between the poles of the second magnet below the release temperature such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another above the release temperature,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream;

(b) inserting the detectable particle provided in step (a) into the batch or continuous stream; and

(c) detecting a change in magnetic field strength of the detectable particle to thereby generate a temperature measurement for the batch or continuous stream.

15. The method of claim 14, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

16. The method of claim 14, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

17. The method of claim 14, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

18. The method of claim 14, wherein the adhesive comprises a material selected from the group consisting of glue materials, metallic alloys, single or multi-component epoxies, epoxy films, thermo-resistant cyanoacrylate adhesives, and combinations thereof.

19. The method of claim 14, wherein the adhesive comprises a metal alloy and a first and second thermo-resistant adhesive, wherein the metal alloy is attached to the first and second magnets via the first and second thermo-resistant adhesive, respectively.

20. The method of claim 14, wherein the adhesive comprises a material selected from the group consisting of indium, bismuth, tin, lead, cadmium, silver, and combinations thereof.

21. The method of claim 14, wherein the release temperature is a conservative temperature.

22. The method of claim 14, wherein the adhesive comprises a release temperature of about between -40°C and 1000°C.

23. The method of claim 14, comprising a carrier particle.

24. The method of claim 23, wherein the carrier particle defines an interior cavity for holding the detectable particle.

25. The method of claim 24, wherein the carrier particle comprises conservative behavior characteristics in a batch or continuous stream of material.

26. The method of claim 14, wherein the first and second magnets comprise a series of magnets each comprising a positive and negative pole, wherein opposing polarity poles of the magnets in series are attached.

27. The method of claim 14, wherein a change from the first magnetic field to the second magnetic field is detected via a sensor positioned proximate to the batch or stream.

28. The method of claim 27, wherein the change is detected via a plurality of sensors positioned proximate to the batch or stream.

29. The method of claim 14, comprising detecting wherein a change from the first magnetic field to the second magnetic field over a predetermined period of time, a predetermined length of a continuous stream, or combinations thereof.

30. The method of claim 29, wherein the change in magnetic field strength is detected via a plurality of successive, parallel, or overlapping

sensors positioned proximate to the continuous stream over the predetermined length of the continuous stream.

31. The method of claim 14, wherein the continuous stream is a particulate-containing food product passing through a thermal processing apparatus.

32. The method of claim 14, comprising recording data associated with the detecting of the change in magnetic field strength.

33. The method of claim 32, wherein the data is stored for documentation, retrieval, analysis, or combinations thereof.

34. The method of claim 33, comprising retrieving the data, analyzing the data, or combinations thereof.

35. A system for generating a temperature measurement for a batch or a continuous stream of material, the system comprising:

(a) a magnetically detectable particle comprising:

(i) a first and second magnet each comprising a positive and negative pole; and

(ii) an adhesive having a release temperature and operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet or between the poles of the second magnet below the release temperature such that a first magnetic field is generated by the first and second magnet, and operable

to release the first and second magnets from one another above the release temperature,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream; and

(b) a detector for detecting a change from the first magnetic field to the second magnetic field to thereby generate a temperature measurement for the batch or continuous stream.

36. The system of claim 35, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

37. The system of claim 35, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

38. The system of claim 35, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

39. The system of claim 35, wherein the adhesive comprises a material selected from the group consisting of glue materials, metallic alloys, single or multi-component epoxies, epoxy films, thermo-resistant cyanoacrylate adhesives, and combinations thereof.

40. The system of claim 35, wherein the adhesive comprises a metal alloy and a first and second thermo-resistant adhesive, wherein the metal alloy is attached to the first and second magnets via the first and second thermo-resistant adhesive, respectively.

41. The system of claim 35, wherein the adhesive comprises a material selected from the group consisting of indium, bismuth, tin, lead, cadmium, silver, and combinations thereof.

42. The system of claim 35, wherein the release temperature is a conservative temperature.

43. The system of claim 35, wherein the adhesive comprises a release temperature of about between -40°C and 1000°C.

44. The system of claim 35, comprising a carrier particle.

45. The system of claim 44, wherein the carrier particle defines an interior cavity for holding the detectable particle.

46. The system of claim 45, wherein the carrier particle comprises conservative behavior characteristics in a batch or continuous stream of material.

47. The system of claim 35, wherein the first and second magnets comprise a series of magnets each comprising a positive and negative pole, wherein opposing polarity poles of the magnets in series are attached.

48. The system of claim 35, wherein the detectable particle comprises a density adjusted to a predetermined target density.

49. The system of claim 48, wherein the target density is that density with the highest likelihood of including the fastest particle.

50. The system of claim 35, wherein the detectable particle further comprises a wall having a thickness, size, shape, composition or combination thereof that imparts a conservative heat transfer characteristic to the detectable particle.

51. The system of claim 35, wherein the detector comprises a magnetic sensor adapted for positioning proximate to the batch or stream.

52. The system of claim 35, comprising a data recorder for recording data detected by the detector.

53 The system of claim 52, comprising a memory operable to store data for documentation, retrieval, analysis, or combinations thereof.

54. A method of generating a temperature measurement for a batch or a continuous stream of material, the method comprising:

(a) providing a plurality of magnetically detectable particles, each particle comprising:

(i) a first and second magnet each comprising a positive and negative pole; and

(ii) an adhesive having a release temperature and operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet or between the poles of the second magnet below the release temperature such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another above the release temperature,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream;

(b) inserting the detectable particles provided in step (a) into the batch or continuous stream; and

(c) detecting a change in magnetic field strength from each of the detectable particles to thereby generate a temperature measurement for the batch or continuous stream.

55. The method of claim 54, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

56. The method of claim 54, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

57. The method of claim 54, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

58. The method of claim 54, wherein the adhesive comprises a material selected from the group consisting of glue materials, metallic alloys, single or multi-component epoxies, epoxy films, thermo-resistant cyanoacrylate adhesives, and combinations thereof.

59. The method of claim 54, wherein the adhesive comprises a metal alloy and a first and second thermo-resistant adhesive, wherein the metal alloy is attached to the first and second magnets via the first and second thermo-resistant adhesive, respectively.

60. The method of claim 54, wherein the adhesive comprises a material selected from the group consisting of indium, bismuth, tin, lead, cadmium, silver, and combinations thereof.

61. The method of claim 54, wherein the release temperature is a conservative temperature.

62. The method of claim 54, wherein the adhesive comprises a release temperature of about between -40°C and 1000°C.

63. The method of claim 54, wherein the detectable particle comprises a carrier particle.

64. The method of claim 63, wherein the carrier particle defines an interior cavity for holding the detectable particle.

65. The method of claim 64, wherein the carrier particle comprises conservative behavior characteristics in a batch or continuous stream of material.

66. The method of claim 54, detecting a change from the first magnetic field to the second magnetic field for each of the particles via a sensor positioned proximate to the batch or stream.

67. The method of claim 66, wherein detecting a change is detected via a plurality of sensors positioned proximate to the batch or stream.

68. The method of claim 54, comprising detecting a change from the first magnetic field to the second magnetic field over a period of time, a predetermined length of a continuous stream, or combinations thereof.

69. The method of claim 68, wherein the change in magnetic field strength is detected via a plurality of successive, parallel, or overlapping sensors positioned proximate to the continuous stream over the predetermined length of the continuous stream.

70. The method of claim 54, wherein the continuous stream is a particulate-containing food product passing through a thermal processing apparatus.

71. The method of claim 54, comprising recording data associated with the detecting of the change in magnetic field strength.

72. The method of claim 71, wherein the data is stored for documentation, retrieval, analysis, or combinations thereof.

73. The method of claim 72, comprising retrieving the data, analyzing the data, or combinations thereof.

74. The method of claim 54, wherein the release temperature of each of the plurality of detectable particles is different.

75. A magnetically detectable particle for generating a temperature measurement for a batch or a continuous stream of material, the particle comprising:

(a) a first, second, and third magnet each comprising a positive and negative pole;

(b) a first adhesive having a first release temperature and operable to attach the negative pole of the first magnet to the negative polarity pole of the second magnet below the first release

temperature, and operable to release the first and second magnets from one another above the first release temperature; and

(c) a second adhesive having a second release temperature and operable to attach the positive pole of the third magnet to the positive pole of the second magnet below the first release temperature, and operable to release the second and third magnets from one another above the first release temperature,

wherein a first magnetic field is generated by the first, second, and third magnets when the first magnet and third magnets are attached to the second magnet,

wherein the first and second magnets move with respect to one another when the first adhesive releases the first and second magnets such that the positive pole of the first magnet moves toward the negative pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a first temperature measurement for the batch or continuous stream, and

wherein the second and third magnets move with respect to one another when the second adhesive releases the second and third magnets such that the negative pole of the third magnet moves toward the positive pole of the second magnet for generating a third magnetic field different than the first magnetic field to indicate a second temperature measurement for the batch or continuous stream.

76. The magnetically detectable particle of claim 75, wherein the first, second, and third magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based,

ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

77. The magnetically detectable particle of claim 75, wherein the first and second adhesive comprises a material selected from the group consisting of glue materials, metallic alloys, single or multi-component epoxies, epoxy films, thermo-resistant cyanoacrylate adhesives, and combinations thereof.

78. The magnetically detectable particle of claim 75, wherein the first and second adhesive comprises a material selected from the group consisting of indium, bismuth, tin, lead, cadmium, silver, and combinations thereof.

79. The magnetically detectable particle of claim 75, wherein the first release temperature is less than the second release temperature such that the first magnet is released from the second magnet at a lower temperature than the third magnet is released from the second magnet for indicating at least two temperature levels.

80. The magnetically detectable particle of claim 75, wherein the second release temperature is less than the first release temperature such that the third magnet is released from the second magnet at a lower temperature than the first magnet is released from the second magnet for indicating at least two temperature levels.

81. The magnetically detectable particle of claim 75, wherein the first release temperature is equal to the second release temperature such that the first and third magnets are released from the second magnets at the same temperature for indicating two temperature levels.

82. The magnetically detectable particle of claim 75, comprising a carrier particle.

83. The magnetically detectable particle of claim 82, wherein the carrier particle defines an interior cavity for holding the first and second adhesives and the first, second, and third magnets.

84. The magnetically detectable particle of claim 83, wherein the carrier particle comprises conservative behavior characteristics in a batch or continuous stream of material.

85. The magnetically detectable particle of claim 75, comprising:

(a) a fourth magnet comprising a positive and negative pole; and

(b) a third adhesive having a third release temperature and operable to attach the negative pole of the third magnet to the negative polarity pole of the fourth magnet below the third release temperature, and operable to release the third and fourth magnets from one another above the third release temperature,

wherein the third and fourth magnets move with respect to one another when the third adhesive releases the third and fourth magnets such that the positive pole of the fourth magnet moves toward the negative pole of the third magnet for generating a fourth magnetic field different than the first magnetic field to indicate a third temperature measurement for the batch or continuous stream.

86. A magnetically detectable particle for generating an environmental condition measurement, the particle comprising:

(a) a first and second magnet each comprising a positive and negative pole; and

(b) an adhesive operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet or between the poles of the second magnet when a predetermined environmental condition is not detected such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another when the predetermined environmental condition is detected,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream.

87. The magnetically detectable particle of claim 86, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets have a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the same polarity pole of the second magnet.

88. The magnetically detectable particle of claim 86, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one

of the positive and negative poles of the first magnet is attached to the same polarity pole of the second magnet.

89. The magnetically detectable particle of claim 86, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

90. The magnetically detectable particle of claim 86, wherein the predetermined environmental condition is detected in the presence of a predetermined analyte.

91. The magnetically detectable particle of claim 90, wherein the predetermined analyte comprises a material selected from the group consisting of a solution having a predetermined pH, carbon dioxide, water, and combinations thereof.

92. The magnetically detectable particle of claim 86, wherein the predetermined environmental condition is detected in the presence of water.

93. The magnetically detectable particle of claim 86, wherein the adhesive degrades in the presence of water.

94. The magnetically detectable particle of claim 86, wherein the predetermined environmental condition is detected in the presence of a predetermined pressure.

95. The magnetically detectable particle of claim 86, wherein the predetermined environmental condition is detected in the presence of a predetermined intensity or frequency of light.

96. The magnetically detectable particle of claim 86, comprising a carrier particle.

97. The magnetically detectable particle of claim 86, wherein the carrier particle defines an interior cavity for holding the adhesive and the first and second magnets.

98. A method of generating an environmental condition measurement in an environment, the method comprising:

(a) providing a magnetically detectable particle comprising:

(i) a first and second magnet each comprising a positive and negative pole; and

(ii) an adhesive operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet when a predetermined environmental condition is not detected such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another when the predetermined environmental condition is detected,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream;

(b) inserting the detectable particle provided in step (a) into the environment; and

(c) detecting a change in magnetic field strength of the detectable particle to thereby generate a temperature measurement for the environment.

99. The method of claim 98, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

100. The method of claim 98, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

101. The method of claim 98, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

102. The method of claim 98, wherein the predetermined environmental condition is detected in the presence of a predetermined analyte.

103. The method of claim 102, wherein the predetermined analyte comprises a material selected from the group consisting of a solution having a predetermined pH, carbon dioxide, water, and combinations thereof.

104. The method of claim 98, wherein the predetermined environmental condition is detected in the presence of water.

105. The method of claim 98, wherein the adhesive degrades in the presence of water.

106. The method of claim 98, wherein the predetermined environmental condition is detected in the presence of a predetermined pressure.

107. The method of claim 98, wherein the predetermined environmental condition is detected in the presence of a predetermined intensity or frequency of light.

108. The method of claim 98, comprising a carrier particle.

109. The method of claim 108, wherein the carrier particle defines an interior cavity for holding the adhesive and the first and second magnets.

110. The method of claim 98, comprising recording data associated with the detecting of the change in magnetic field strength.

111. The method of claim 110, wherein the data is stored for documentation, retrieval, analysis, or combinations thereof.

112. The method of claim 111, comprising retrieving the data, analyzing the data, or combinations thereof.

113. A system for generating an environmental condition measurement for an environment, the system comprising:

(a) a magnetically detectable particle comprising:

(i) a first and second magnet each comprising a positive and negative pole; and

(ii) an adhesive operable to attach one of the positive and negative poles of the first magnet to the same polarity pole of the second magnet when a predetermined environmental condition is not detected such that a first magnetic field is generated by the first and second magnet, and operable to release the first and second magnets from one another when the predetermined environmental condition is detected,

wherein the first and second magnets move with respect to one another when the adhesive releases the first and second magnets such that one of the positive and negative poles of the first magnet moves toward the opposing polarity pole of the second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream; and

(b) a detector for detecting a change from the first magnetic field to the second magnetic field to thereby generate an environmental condition measurement for the environment.

114. The system of claim 113, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is about the same as the third magnetic field strength such that the first magnetic field strength is about zero when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

115. The system of claim 113, wherein the first magnetic field has a first magnetic field strength, wherein the first and second magnets comprise a second and third magnetic field strength, respectively, wherein the second magnetic field strength is greater than the third magnetic field strength such that the first magnetic field strength is detectable when one of the positive and negative poles of the first magnet is attached to the opposing polarity positive or negative pole of the second magnet.

116. The system of claim 113, wherein the first and second magnets can comprise a material selected from the group consisting of neodymium iron boron, cobalt rare earth, aluminum-based, ceramic, organic, plastic-embedded metal or ceramic, neodymium-iron-boron grades, and combinations thereof.

117. The system of claim 113, wherein the predetermined environmental condition is detected in the presence of a predetermined analyte.

118. The system of claim 117, wherein the predetermined analyte comprises a material selected from the group consisting of a solution having a predetermined pH, carbon dioxide, water, and combinations thereof.

119. The system of claim 113, wherein the predetermined environmental condition is detected in the presence of water.

120. The system of claim 113, wherein the adhesive degrades in the presence of water.

121. The system of claim 113, wherein the predetermined environmental condition is detected in the presence of a predetermined pressure.

122. The system of claim 113, wherein the predetermined environmental condition is detected in the presence of a predetermined intensity or frequency of light.

123. The system of claim 113, comprising a carrier particle.

124. The system of claim 123, wherein the carrier particle defines an interior cavity for holding the adhesive and the first and second magnets.

125. The system of claim 113, wherein the detector comprises a magnetic sensor adapted for positioning proximate to the batch or stream.

126. The system of claim 113, comprising a data recorder for recording data detected by the detector.

127. The system of claim 126, comprising a memory operable to store data for documentation, retrieval, analysis, or combinations thereof.

128. A carrier particle comprising one or more magnetically detectable particles of claims 1, 75, or 86 and combinations thereof.

129. A magnetically detectable particle for generating a temperature measurement for a batch or a continuous stream of material, the particle comprising:

(a) a plurality of sets of first and second magnets, each of the first and second magnets comprising a positive and negative pole; and

(b) a plurality of adhesives each corresponding to one of the sets of first and second magnets, the adhesives each having a release temperature and each adhesive operable to attach one of the positive and negative poles of the corresponding first magnet between the positive and negative poles of the corresponding second magnet below the release temperature such that a first magnetic field is generated by the corresponding first and second magnet, and each adhesive operable to release the first and second magnets from one another above the release temperature; and

wherein the corresponding first and second magnets move with respect to one another when the adhesive releases the corresponding first and second magnets such that one of the positive and negative poles of the corresponding first magnet moves toward the opposing polarity pole of the corresponding second magnet for generating a second magnetic field different than the first magnetic field to indicate a temperature measurement for the batch or continuous stream.

130. The magnetically detectable particle of claim 129, wherein each adhesive of the plurality of adhesives has different release temperatures.

131. The magnetically detectable particle of claim 129, wherein each adhesive of the plurality of adhesives has similar release temperatures.

132. A device for generating a temperature measurement for a batch or continuous stream of material, the detectable particle comprising:

(a) a detectable particle comprising a signal that changes at a predetermined temperature; and

(b) a carrier particle comprising an interior cavity holding the detectable particle, wherein the carrier particle comprises a conservative behavior characteristic matching a target particle, wherein the thermal protection provided by the carrier particle to the interior cavity is greater than or equivalent to conservative thermal behavior of a target particle at its cold spot under similar heating conditions.

133. The device of claim 132, wherein the conservative behavior characteristics of the target particle comprise conservative dimensional and thermal characteristics.

134. The device of claim 133, wherein the conservative dimensional characteristic comprises a cube shape.

135. The device of claim 133, wherein the conservative dimensional characteristic comprises a cylindrical shape.

136. The device of claim 133, wherein the conservative thermal characteristic comprises a density between about 10 kg/m^3 and 20,000 kg/m^3.

137. The device of claim 132, wherein the carrier particle comprises a material selected from the group consisting of polymer, biopolymer, and combinations thereof.

138. The device of claim 132, wherein the carrier particle comprises polypropylene.

139. The device of claim 132, wherein the carrier particle comprises methylpentene copolymer (TPX).

140. The device of claim 132, wherein the carrier particle comprises nylon.

141. The device of claim 132, wherein the carrier particle comprises a specific heat between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

142. The device of claim 132, wherein the carrier particle comprises a thickness between the interior cavity and an outside surface of the carrier particle providing conservative thermal protection to the interior cavity.

143. A method of generating a temperature measurement for a batch or a continuous stream of material, the method comprising:

(a) providing a device comprising:

(i) a detectable particle comprising a signal that changes at a predetermined temperature; and

(ii) a carrier particle comprising an interior cavity holding the detectable particle, wherein the carrier particle comprises a conservative behavior characteristic matching a target particle, wherein the thermal protection provided by the carrier particle to the interior cavity is greater than or equivalent to conservative behavior characteristics of a target particle to the cold spot under similar heating conditions;

(b) inserting the device provided in step (a) into the batch or continuous stream; and

(c) detecting a signal change of the device to thereby generate a temperature measurement for the batch or continuous stream.

144. The method of claim 143, wherein the conservative behavior characteristics of the target particle comprise conservative dimensional and thermal characteristics.

145. The method of claim 144, wherein the conservative dimensional characteristic comprises a cube shape.

146. The method of claim 144, wherein the conservative dimensional characteristic comprises a cylindrical shape.

147. The method of claim 144, wherein the conservative thermal characteristic comprises a density between about 10 kg/m^3 and 20,000 kg/m^3.

148. The method of claim 143, wherein the carrier particle comprises a material selected from the group consisting of polymer, biopolymer, and combinations thereof.

149. The method of claim 143, wherein the carrier particle comprises polypropylene.

150. The method of claim 143, wherein the carrier particle comprises methylpentene copolymer (TPX).

151. The method of claim 143, wherein the carrier particle comprises nylon.

152. The method of claim 143, wherein the carrier particle comprises a specific heat between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

153. The method of claim 143, wherein the carrier particle comprises a thickness between the interior cavity and an outside surface of the carrier particle providing conservative thermal protection to the interior cavity.

154. A method of providing a carrier particle with conservative behavior characteristics in a batch or continuous stream of material, the method comprising:

(a) determining conservative behavior characteristics of a target particle found in a batch or continuous stream of material; and

(b) determining material and dimensions for a carrier particle design that substantially correspond to one or more conservative behavior characteristics of the target particle.

155. The method of claim 154, wherein the conservative behavior characteristics of the target particle comprise conservative dimensional and thermal characteristics.

156. The method of claim 155, wherein the conservative dimensional characteristic comprises a first cube shape.

157. The method of claim 156, wherein the carrier particle design comprises a second cube shape about matching the first cube shape.

158. The method of claim 155, wherein the conservative dimensional characteristic comprises a first cylindrical shape.

159. The method of claim 158, wherein the carrier particle design comprises a second cylindrical shape about matching the first cylindrical shape.

160. The method of claim 155, wherein the conservative thermal characteristic comprises a density between about 10 kg/m^3 and 20,000 kg/m^3.

161. The method of claim 160, wherein the carrier particle design comprises polymer or biopolymer characteristics.

162. The method of claim 160, wherein the carrier particle design comprises polypropylene characteristics.

163. The method of claim 160, wherein the carrier particle design comprises methylpentene copolymer (TPX) characteristics.

164. The method of claim 160, wherein the carrier particle design comprises nylon characteristics.

165. The method of claim 154, wherein the conservative behavior characteristic comprises a specific heat between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

166. The method of claim 165, wherein the carrier particle design comprises specific heat characteristics of between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

167. The method of claim 154, wherein the target particle comprises a cold spot.

168. The method of claim 167, wherein the carrier particle design defines an interior cavity for holding a particle operable to indicate a temperature measurement.

169. The method of claim 168, wherein the thermal protection provided by the carrier particle design to the interior cavity is greater than or equivalent to the thermal protection provided by the target particle to the cold spot under similar heating conditions.

170. The method of claim 169, wherein determining conservative material and dimensions comprises determining a conservative thickness of the carrier particle design between the interior cavity and an outside surface of the carrier particle.

171. The method of claim 169, wherein determining behavior characteristics of the target particle design comprises heating the target particle until an interior of the target particle design receives a first conservative time-temperature treatment.

172. The method of claim 171, wherein the carrier particle design comprises a size and shape similar to the target particle, and wherein the carrier particle design defines an interior cavity and a wall separating the interior cavity from an exterior surface of the carrier particle design; and

comprising determining a thickness, size, shape, composition or combination thereof of the wall of the carrier particle design at which the interior cavity of the simulation particle receives a second conservative time-temperature treatment, wherein the second conservative time-temperature treatment is about equivalent to the first conservative time-temperature treatment.

173. The method of claim 172, wherein the wall of the carrier particle design is about equal to the thickness of the determined wall thickness of the carrier particle.

174. The method of claim 154, wherein the step of determining conservative behavior characteristics comprises:

(a) applying simulated heat to the target particle; and

(b) determining the time required for a cold spot of the target particle to achieve a predetermined lethality value.

175. The method of claim 174, wherein the cold spot is the geometric center of the target particle.

176. The method of claim 174, wherein the predetermined lethality value is about 3 minutes.

177. The method of claim 174, comprising applying the same simulated heat to the carrier particle design as applied to the target particle for the time determined to achieve the predetermined lethality in the cold spot of the target particle.

178. The method of claim 177, comprising determining lethality applied to interior portions of the carrier particle design.

179. The method of claim 178, comprising determining the position of a wall of an interior cavity of the carrier particle based on the interior portions of the carrier particle design having an applied lethality lower than the predetermined lethality value.

180. The method of claim 154, comprising fabricating an actual carrier particle comprising the material and dimensions about equivalent to the carrier particle design.

181. The method of claim 154, comprising displaying a representation of the carrier particle design.

182. The method of claim 154, comprising displaying the conservative behavior characteristics of the target particle.

183. A method of providing a carrier particle with conservative behavior characteristics in a batch or continuous stream of material, the method comprising:

(a) simulating thermal treatment of a target particle until a predetermined lethality is accumulated;

(b) simulating a carrier particle under the same thermal treatment simulated in step (a), wherein the carrier particle comprises an interior cavity and a wall; and

(c) determining a conservative thickness for the wall of the carrier particle such that the interior cavity of the carrier particle can

receive the same predetermined lethality as the target particle under the thermal treatment simulated in step (a).

184. The method of claim 183, wherein the predetermined lethality is accumulated at the center of the target particle.

185. The method of claim 183, wherein simulating thermal treatment of the target particle comprises determining a heating time for accumulating the predetermined lethality.

186. The method of claim 185, wherein simulating the carrier particle comprises applying the thermal treatment for the heating time.

187. The method of claim 183, wherein determining a conservative thickness for the wall comprises examining the spatial lethality distribution within the carrier particle.

188. The method of claim 183, wherein the step of simulating thermal treatment comprises:

(a) applying simulated heat to the target particle; and

(b) determining the time required for a cold spot of the target particle to achieve a predetermined lethality value.

189. The method of claim 188, wherein the cold spot is the geometric center of the target particle.

190. The method of claim 188, wherein the predetermined lethality value is about 3 minutes.

191. The method of claim 188, comprising applying the same simulated heat to the carrier particle design as applied to the target particle for the time determined to achieve the predetermined lethality in the cold spot of the target particle.

192. The method of claim 191, comprising determining lethality applied to interior portions of the carrier particle design.

193. The method of claim 192, wherein determining the conservative thickness for the wall of the carrier particle comprises determining the position of a wall of an interior cavity of the carrier particle based on the interior portions of the carrier particle design having an applied lethality lower than the predetermined lethality value.

194. The method of claim 183, comprising providing target particle characteristics selected from the group consisting of thermophysical properties, shape, dimensions, and combinations thereof.

195. The method of claim 183, comprising providing carrier particle characteristics selected from the group consisting of thermophysical properties, shape, dimensions, and combinations thereof.

196. The method of claim 183, comprising providing thermal treatment characteristics selected from the group consisting of initial temperature of one of the target and carrier particles, ambient temperature, fluid-to-particle heat transfer coefficient, predetermined thermal treatment at the center of one of the target and carrier particles.

197. The method of claim 183, determining a density for the carrier particle.

198. The method of claim 183, comprising displaying simulation results of step (a).

199. The method of claim 183, comprising displaying simulation results of step (b).

200. The method of claim 183, comprising displaying a model of the target particle.

201. The method of claim 183, comprising displaying a model of the carrier particle.

202. A system for aiding the design of a carrier particle with conservative behavior characteristics in a batch or continuous stream of material, the system comprising:

(a) a memory comprising conservative behavior characteristics of a target particle used in a batch or continuous stream of material; and

(b) a spatial simulation engine operable to simulate material and dimensions of a carrier particle design for matching the conservative behavior characteristics of the target particle.

203. The system of claim 202, wherein the conservative behavior characteristics of the target particle comprise conservative dimensional and thermal characteristics.

204. The system of claim 203, wherein the conservative dimensional characteristic comprises a first cube shape.

205. The system of claim 204, wherein the carrier particle design comprises a second cube shape about matching the first cube shape.

206. The system of claim 203, wherein the conservative dimensional characteristic comprises a first cylindrical shape.

207. The system of claim 206, wherein the carrier particle design comprises a second cylindrical shape about matching the first cylindrical shape.

208. The system of claim 203, wherein the conservative thermal characteristic comprises a density between about 10 kg/m^3 and 20,000 kg/m^3.

209. The system of claim 208, wherein the carrier particle design comprises polymer or biopolymer characteristics.

210. The system of claim 208, wherein the carrier particle design comprises polypropylene characteristics.

211. The system of claim 208, wherein the carrier particle design comprises methylpentene copolymer (TPX) characteristics.

212. The system of claim 208, wherein the carrier particle design comprises nylon characteristics.

213. The system of claim 202, wherein the conservative characteristic behavior comprises a specific heat between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

214. The system of claim 213, wherein the carrier particle design comprises specific heat characteristics of between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

215. The system of claim 202, wherein the target particle comprises a cold spot.

216. The system of claim 215, wherein the carrier particle design defines an interior cavity for holding a particle operable to indicate a temperature measurement.

217. The system of claim 216, wherein the thermal protection provided by the carrier particle design to the interior cavity is greater than or equivalent to the thermal protection provided by the target particle to the cold spot under similar heating conditions.

218. The system of claim 217, wherein the spatial simulation engine is operable to simulate the carrier particle design with a conservative thickness between the interior cavity and an outside surface of the carrier particle design.

219. The system of claim 217, wherein the spatial simulation engine is operable to simulate heating of the target particle until an interior of the target particle design receives a first conservative time-temperature treatment.

220. The system of claim 219, wherein the carrier particle design comprises a size and shape similar to the target particle, and wherein the carrier particle design defines an interior cavity and a wall separating the interior cavity from an exterior surface of the carrier particle design; and

wherein the spatial simulation engine is operable to simulate a thickness, size, shape, composition or combination thereof of the wall of the carrier particle design for applying a second conservative time-temperature treatment the interior cavity of the simulation particle, wherein the second

conservative time-temperature treatment is about equivalent to the first conservative time-temperature treatment.

221. The system of claim 220, wherein the wall of the carrier particle design is about equal to the thickness of the determined wall thickness of the carrier particle.

222. The system of claim 216, wherein the spatial simulation engine is operable to simulate the application of heat to the target particle; and determine the time required for the cold spot of the target particle to achieve a predetermined lethality value.

223. The system of claim 222, wherein the cold spot is the geometric center of the target particle.

224. The system of claim 222, wherein the predetermined lethality value is about 3 minutes.

225. The system of claim 222, wherein the spatial simulation engine is operable to apply the same simulated heat to the carrier particle design as applied to the target particle for the time determined to achieve the predetermined lethality in the cold spot of the target particle.

226. The system of claim 225, wherein the spatial simulation engine is operable to determine lethality applied to interior portions of the carrier particle design.

227. The system of claim 226, wherein the spatial simulation engine is operable to determine the position of a wall of an interior cavity of the carrier particle based on the interior portions of the carrier particle design having an applied lethality lower than the predetermined lethality value.

228. The system of claim 202, comprising a display for displaying a representation of the carrier particle design.

229. The system of claim 202, comprising a display for displaying the conservative behavior characteristics of the target particle.

230. A computer-readable medium having stored thereon instructions for aiding the design of a carrier particle with conservative behavior characteristics in a batch or continuous stream of material, comprising:

(a) determining conservative behavior characteristics of a target particle used in a batch or continuous stream of material; and

(b) determining material and dimensions for a carrier particle design about matching the conservative behavior characteristics of the target particle.

231. The computer-readable medium of claim 230, wherein the conservative behavior characteristics of the target particle comprise conservative dimensional and thermal characteristics.

232. The computer-readable medium of claim 231, wherein the conservative dimensional characteristic comprises a first cube shape.

233. The computer-readable medium of claim 232, wherein the carrier particle design comprises a second cube shape about matching the first cube shape.

234. The computer-readable medium of claim 231, wherein the conservative dimensional characteristic comprises a first cylindrical shape.

235. The computer-readable medium of claim 234, wherein the carrier particle design comprises a second cylindrical shape about matching the first cylindrical shape.

236. The computer-readable medium of claim 231, wherein the conservative thermal characteristic comprises a density between about 10 kg/m^3 and 20,000 kg/m^3.

237. The computer-readable medium of claim 236, wherein the carrier particle design comprises polymer or biopolymer characteristics.

238. The computer-readable medium of claim 236, wherein the carrier particle design comprises polypropylene characteristics.

239. The computer-readable medium of claim 236, wherein the carrier particle design comprises methylpentene copolymer (TPX) characteristics.

240. The computer-readable medium of claim 236, wherein the carrier particle design comprises nylon characteristics.

241. The computer-readable medium of claim 230, wherein the conservative characteristic behavior comprises a specific heat between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

242. The computer-readable medium of claim 241, wherein the carrier particle design comprises specific heat characteristics of between about 122 J/(kg·°C) and 4,186 J/(kg·°C).

243. The computer-readable medium of claim 230, wherein the target particle comprises a cold spot.

244. The computer-readable medium of claim 243, wherein the carrier particle design defines an interior cavity for holding a particle operable to indicate a temperature measurement.

245. The computer-readable medium of claim 244, wherein the thermal protection provided by the carrier particle design to the interior cavity is greater than or equivalent to the thermal protection provided by the target particle to the cold spot under similar heating conditions.

246. The computer-readable medium of claim 245, wherein determining conservative material and dimensions comprises determining a conservative thickness of the carrier particle design between the interior cavity and an outside surface of the carrier particle.

247. The computer-readable medium of claim 245, wherein determining behavior characteristics of the target particle design comprises heating the target particle until an interior of the target particle design receives a first conservative time-temperature treatment.

248. The computer-readable medium of claim 247, wherein the carrier particle design comprises a size and shape similar to the target particle, and wherein the carrier particle design defines an interior cavity and a wall separating the interior cavity from an exterior surface of the carrier particle design; and

comprising determining a thickness, size, shape, composition or combination thereof of the wall of the carrier particle design at which the interior cavity of the simulation particle receives a second conservative time-temperature treatment, wherein the second conservative time-temperature

treatment is about equivalent to the first conservative time-temperature treatment.

249. The computer-readable medium of claim 248, wherein the wall of the carrier particle design is about equal to the thickness of the determined wall thickness of the carrier particle.

250. The computer-readable medium of claim 230, wherein the step (a) comprises:

(a) applying simulated heat to the target particle; and

(b) determining the time required for a cold spot of the target particle to achieve a predetermined lethality value.

251. The computer-readable medium of claim 250, wherein the cold spot is the geometric center of the target particle.

252. The computer-readable medium of claim 250, wherein the predetermined lethality value is about 3 minutes.

253. The computer-readable medium of claim 250, comprising applying the same simulated heat to the carrier particle design as applied to the target particle for the time determined to achieve the predetermined lethality in the cold spot of the target particle.

254. The computer-readable medium of claim 253, comprising determining lethality applied to interior portions of the carrier particle design.

255. The computer-readable medium of claim 254, comprising determining the position of a wall of an interior cavity of the carrier particle

based on the interior portions of the carrier particle design having an applied lethality lower than the predetermined lethality value.

256. A computer-readable medium having stored thereon instructions for aiding the design of a carrier particle with conservative behavior characteristics in a batch or continuous stream of material, comprising:

(a) simulating thermal treatment of a target particle until a predetermined lethality is accumulated;

(b) simulating a carrier particle under the same thermal treatment simulated in step (a), wherein the carrier particle comprises an interior cavity and a wall; and

(c) determining a conservative thickness for the wall of the carrier particle such that the interior cavity of the carrier particle can receive the same predetermined lethality as the target particle under the thermal treatment simulated in step (a).

257. The computer-readable medium of claim 256, wherein the predetermined lethality is accumulated at the center of the target particle.

258. The computer-readable medium of claim 256, wherein simulating thermal treatment of the target particle comprises determining a heating time for accumulating the predetermined lethality.

259. The computer-readable medium of claim 258, wherein simulating the carrier particle comprises applying the thermal treatment for the heating time.

260. The computer-readable medium of claim 256, wherein determining a conservative thickness for the wall comprises examining the spatial lethality distribution within the carrier particle.

261. The computer-readable medium of claim 256, wherein step (a) comprises:

(a) applying simulated heat to the target particle; and

(b) determining the time required for a cold spot of the target particle to achieve a predetermined lethality value.

262. The computer-readable medium of claim 261, wherein the cold spot is the geometric center of the target particle.

263. The computer-readable medium of claim 261, wherein the predetermined lethality value is about 3 minutes.

264. The computer-readable medium of claim 261, comprising applying the same simulated heat to the carrier particle design as applied to the target particle for the time determined to achieve the predetermined lethality in the cold spot of the target particle.

265. The computer-readable medium of claim 264, comprising determining lethality applied to interior portions of the carrier particle design.

266. The computer-readable medium of claim 265, wherein determining the conservative thickness for the wall of the carrier particle comprises determining the position of a wall of an interior cavity of the carrier particle based on the interior portions of the carrier particle design having an applied lethality lower than the predetermined lethality value.

267. The computer-readable medium of claim 256, comprising providing target particle characteristics selected from the group consisting of thermophysical properties, shape, dimensions, and combinations thereof.

268. The computer-readable medium of claim 256, comprising providing carrier particle characteristics selected from the group consisting of thermophysical properties, shape, dimensions, and combinations thereof.

269. The computer-readable medium of claim 256, comprising providing thermal treatment characteristics selected from the group consisting of initial temperature of one of the target and carrier particles, ambient temperature, fluid-to-particle heat transfer coefficient, and predetermined thermal treatment at the center of one of the target and carrier particles.

270. The computer-readable medium of claim 256, determining a density for the carrier particle.

271. The computer-readable medium of claim 256, comprising displaying simulation results of step (a).

272. The computer-readable medium of claim 256, comprising displaying simulation results of step (b).

273. The computer-readable medium of claim 256, comprising displaying a model of the target particle.

274. The computer-readable medium of claim 256, comprising displaying a model of the carrier particle.